Executive Summary

A Review of the Economic Impacts of AOSIS-Type Proposals to Limit Carbon Dioxide Emissions

Prepared for:
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I. Executive Summary

Overview

As directed by the Conference of the Parties, the Ad Hoc Group on the Berlin Mandate is considering proposals to limit greenhouse gas emissions in the post-2000 period. For example, a group of countries called the Alliance of Small Island States (AOSIS) proposed a protocol to the Framework Convention on Climate Change that would require Annex I countries (OECD, eastern Europe, and former Soviet Union) to limit their carbon dioxide emissions to 20 percent below 1990 levels by 2005. This study compares and contrasts existing macroeconomic modeling studies which use carbon taxes as a proxy for the marginal cost of abatement to evaluate the potential impact of similar, but less stringent, emission reduction proposals.

This analysis indicates large economic costs would be incurred with adoption of an AOSIS-type proposal. The impact on the U.S. likely would be greater than for other Annex I countries and the economic and employment impacts of rapid emission limitations would be felt unevenly across geographic regions and industries within a given country. The authors conclude that:

For the United States:

- The tax rate to achieve an AOSIS-type target by 2005 likely would be in excess of $280 (1994 dollars) per metric ton of carbon emissions;
- Economic losses of 3-3.5% of GDP would be expected -- this is equivalent to a reduction of $262 billion to $305 billion in GDP per year in today's economy;
- The GDP loss (in 1994 dollars) would be $509 to $592 per metric ton reduction in carbon emissions;
- Energy intensive industries and their employees would be hit hardest.

For other OECD Countries:

- The economic effort required to meet an AOSIS-type target would vary substantially across countries;
- Reductions in GDP of 0.7% to 2.0% in 2010 could be expected, but countries with relatively rapid population growth would suffer greater reductions in GDP;
- GDP losses (in 1994 dollars) of $200 to $500 for each metric ton reduction in carbon emissions could be expected;

For Developing Countries:

- Developing countries would not be required to reduce emissions but they would be impacted by the domestic actions taken by Annex I countries;
- While this impact might not appear large in the aggregate, there would be clear winners and losers among developing countries with impacts varying substantially among "newly developed" and "developing" countries;
- To the extent that developing countries benefit from Annex I emission reduction efforts, their emissions would increase and offset Annex I country emission reduction efforts.

Alternatives to AOSIS-Type Proposals:

- Given the large economic impacts of proposals to rapidly reduce emissions, analysts, and policymakers need to look beyond the debate over immediate emission reductions and address issues of long-term timing of emission reductions and international cooperation.

Study Description

The Alliance of Small Island States (AOSIS) proposed a protocol to the Framework Convention on Climate Change that would require Annex I countries to limit their carbon dioxide emissions to 20 percent below 1990 levels by 2005. The proposal also calls for policies, but no specific targets, to reduce emissions of other greenhouse gases. This and other proposals would place binding limits on carbon dioxide emissions from Annex I countries; none of these proposals would impose any limitation on greenhouse gas emissions from developing countries.

This study compares and contrasts existing macroeconomic modeling evaluations of the potential impact of emission reduction proposals. None of the studies currently available for review investigated the impact of limiting emissions to 20% below 1990 levels over a such a short time span (less than ten years), so this analysis describes the economic impact of less severe restrictions. Most of the studies investigated the impact on economic growth of a 20 percent reduction in carbon emissions from 1990 levels by the year 2010. These results give an indication of the range of minimum impacts to be expected under an AOSIS-type proposal, and indicate the importance of assessments of the impact of proposals requiring rapid and deep reductions.

The Emission Gap: Agreeing to meet such proposals would likely have a significant impact, particularly on the U.S. economy. For example, U.S. carbon emissions in 1995 were 32% greater than would be allowed under the AOSIS protocol. In 2005, according to the Energy Information Administration's Annual Energy Outlook 1996 reference case, carbon emissions are projected to exceed an AOSIS-type target level (0.8 * 1337 = 1070) by almost 48%, even accounting for the "no-regrets" or "low-regrets" agenda developed and pursued under the Climate Change Action Plan.

U.S. Carbon Emissions
(Million Metric Tons)

1990	1337.2
1995	1413.2
2005	1585.2

Source: Annual Energy Outlook, 1996

Study Conclusions

All of the studies reviewed used carbon taxes -- a proxy for the marginal cost of abatement -- as the mechanism for reducing carbon from the energy sector, and all of the studies offset the revenue from the tax with reductions in other tax revenue sources. While other mechanisms might be used to achieve similar goals, economic theory indicates that they would cost at least as much as the carbon taxes assumed in these models.

The models reviewed here fall into two major categories: econometrically estimated partial equilibrium models and computable general equilibrium (CGE) models. In general, the econometric models provide insight into the economic costs of the carbon tax policy accounting, or perhaps concentrating, on the rigidities in the energy/economic system such as a long and costly adjustment process for the capital stock, while the computable general

equilibrium models indicate the long-run market equilibrium solutions for the estimated carbon tax and its associated economic costs.

The results of this analysis show a large economic cost to the U.S. associated with adoption of an AOSIS-type proposal. To achieve a reduction in emissions of up to 20% from the 1990 levels by 2010, the econometric models estimate tax levels of approximately $200-$400 (1990$) per ton carbon emission. The associated GDP loss is estimated to be 4.2% at its peak, averaging 3.5% for the period 2005-2015 (a more comparable number to the estimates derived from CGE models.) To achieve the same objective, most of the computable general equilibrium models estimate tax levels of $126-$306 (1990$) per ton leading to GDP losses in the range of 0.9%-1.5%. The DGEM and Goulder models estimate similar economic impacts although the carbon tax is not as large due to the rapidity of their market clearing mechanism.

Model Results for U.S. in 2010

	EPRI (94) DRI (92)		EMF12 (94) DGEM GOULDER		EMF12 (94) Rest of EMF12		OECD Study (92)	
	H	L	H	L	H	L	H	L
Carbon Tax (as reported)	$384 ($89)	$200 ($92)	$50 ($90)	$50 ($90)	$260 ($90)	$160 ($90)	$306 ($90)	$126 ($90)
Carbon Tax (in $94)	$450	$210	$56	$56	$292	$180	$343	$141
Loss of GDP (%)	4.2%	4.2%	1.7%	1.2%	1.5%	0.9%	1.3%	0.9%
1994 GDP Dollar Loss per metric ton reduction	$820	$591	$218	$154	$147	$94	$160	$117

Given the structural differences in the model types, we concluded that the tax rate to achieve a 20% emission reduction from 1990 levels by 2010 is likely to be between the lower bound of the range suggested by the econometric models and the higher bound estimated by the CGE models, or in the $200-$300 (1990$) range. The associated economic costs, therefore, are likely to be a reduction of 1.5%-3.5% of GDP. The models also suggest that the economic costs associated with emission reduction are likely to be relatively higher in the early years due to the stickiness of capital stock in adjusting to changes in energy prices. This implies that the costs of emission reduction for the year 2005 are likely to be closer to the upper bound of the range estimated for 2010. If imposed, a carbon tax of this magnitude would lower the projected level of GDP in 2005 by 3-3.5%.

Assessment of the Probable Impact on the U.S. Economy of Adoption of an AOSIS-type Proposal

	2005
Carbon Tax ($90/metric ton)	$250-$300
Carbon Tax ($94/metric ton)	$280-$336
Loss of GDP (%)	3% - 3.5%
GDP Loss[1] (billion 94$)	$262 - $305
GDP Loss / metric ton of carbon[1]	$509 - $592

[1] Calculated using baseline projections of real GDP inflated to 1994 dollars by the implicit price deflator and carbon emissions for 2005, EIA Annual Energy Outlook, 1996

U.S. Sectoral, Regional and Employment Impacts

While all the studies reviewed in this report examined the magnitude of the losses in real GDP relative to the baseline, as well as the losses borne by the energy sector, only one study, "Economic Impacts of Carbon Taxes: Overview and Detailed Results" prepared for EPRI by DRI/McGraw-Hill and Charles River Associates, investigated the impact of several large carbon taxes on sectoral and employment performance. According to the EPRI study, the carbon tax would have the most impact on employment in energy-producing areas. A $100 carbon tax would result in a 1.1% job loss relative to baseline levels by 2010 in the West South Central census region where oil and gas producing industries are concentrated. Regions where electricity is primarily generated from coal such as the East South Central and South Atlantic would also face a greater than average decline in manufacturing employment.

The impact of the carbon tax across industries will vary depending on their energy usage. The impact will be the largest on energy producing industries such as oil, natural gas, coal and electricity. Among non-energy industries, mining operations and industries in early stages of processing (such as chemicals) would be the most affected by the carbon tax.

Economic Impact on Rest of World of AOSIS-type Proposals

Rest of OECD: Comparison of the results for the U.S. and the Rest of the OECD indicate that the impact of a given reduction target would be greater for the U.S. Population increases represent the most direct demand for additional energy resources, and U.S. population growth is projected to grow nearly 0.9% per year. Another important element of a country's ability to meet carbon reduction targets is its current energy intensity. In the U.S., the bulk of the emission reductions through 2010 would be achieved through lower energy usage rather than fuel switching. Given the slow rate of turnover in capital stock over the near to mid-term (10 to 15 years), energy prices would have to rise considerably to induce reductions in use resulting in a significant slowing in economic growth relative to the baseline.

Model Results for Rest of OECD in 2010

	DRI (92)				OECD Study (92)	
	Japan	Australia	OECD-Europe	Canada	H	L
Carbon Tax (as reported)	$1100 ($89)	$783 ($89)	$600 ($89)	$431 ($89)	$240 ($90)	$129 ($90)
Carbon Tax ($94)	$1288	$916	$702	$505	$269	$145
Loss of GDP (%)	1.5%	3.9%	2.0%	3.2%	0.9%	0.3%
1994 GDP Dollar Loss per metric ton reduction	$725	$306	$495	$484	$326	$77

Note: Carbon tax values inflated by the U.S. implicit price deflator.

While the carbon taxes are significantly different between the DRI/McGraw-Hill study and the OECD study, the reported economic impact by country or for regions within the OECD is more similar. The range of impacts in the OECD study center around 0.7% in 2010. In the DRI/McGraw-Hill study, the impacts are higher: 1.5%-3.9% in 2010. The DRI study implies a

$300-$725 (1994$) loss in GDP per metric ton of emission reduction, while the rest of the OECD study results are $100-$326 (1990$) per metric ton. The major difference between the two studies is the treatment of the rest of the OECD in regions versus specific-countries. In the DRI study, the explicit investigation of the countries led to a conclusion that the ability of the other OECD countries to meet specific target over the near term was very limited. Due to the existing energy taxes in the rest of the OECD, limited opportunities for near term expansion of natural gas above levels already included in the base case, combined with the assumption of no trading of emission rights, results in a very leveraged impact on the level of the carbon tax needed to achieve significant emission reductions in the succeeding twenty years. Treatment of the rest of the OECD in a more aggregate form, often as one region, implicitly assumes greater flexibility in the region's ability to meet the goal.

Developing Countries: As an adjunct to the DRI/McGraw-Hill studies, analyses were performed to quantify the impact of carbon limitation programs in the OECD on developing countries. These analyses were performed to ascertain if the imposition of OECD fossil fuel taxes or restrictions would benefit developing countries.

The aggregate results for the world regions show little impact from the baseline in both studies. However, these aggregate results are deceiving: there are clearly defined winners and losers, and the disparity between the winners and losers begs for a reclassification of the countries between "newly developed" and "developing." Across the world, the newly developed have been identified as clear winners: countries positioned to take advantage of a self-imposed economic constraint within the OECD.

The losers, on the other hand, will not only suffer because of economic reversals within the OECD, but will require additional help from the OECD to support their economies, when the OECD will be in a worsened position to supply it. The developing world will not participate equally in the "leakage" of carbon intensive industrial activity from the OECD: the few winners take all. Finally, the shift in economic performance towards a few countries positioned to replace most of the industrial output formerly produced by the OECD results in world carbon emissions insignificantly reduced from the baseline.

Alternatives to AOSIS

Given the economic impacts cited above, both scientists and policy makers need to look beyond the debate over immediate reductions and begin to address the timing of reductions and international cooperation. Carbon dioxide concentrations, not annual emissions, influence global climate change. Therefore, by allowing greater flexibility in the timing of emission reductions, the cost of such reductions could be significantly reduced without changing the ultimate atmospheric concentration. An underlying factor related to timing focuses on the value of information, which means delaying draconian actions until scientific knowledge is improved and can reduce uncertainty, and thereby avoiding abatement costs that ultimately might not be needed. Also, the deferring of emissions reductions would provide valuable time to deploy low cost carbon free technologies.

In conjunction with the issue of timing, policymakers need to foster international cooperation among the OECD and the rest of the world. The potential cooperation among nations would lead to a more cost-effective way of attaining future carbon dioxide targets.

Attachment 1

Impact of Carbon Taxes on Energy Prices

Energy Type	1995 Prices Estimated	$100/Mt Carbon Tax 1995 Prices plus Carbon Tax	$100/Mt Carbon Tax Percent Increase	$280/Mt Carbon Tax 1995 Prices plus Carbon Tax	$280/Mt Carbon Tax Percent Increase	$336/Mt Carbon Tax 1995 Prices plus Carbon Tax	$336/Mt Carbon Tax Percent Increase
Petroleum (Cents per Gallon)							
Home Heating Oil	86.64	113.84	31.4%	162.80	87.9%	178.03	105.5%
Motor Gasoline	120.62	147.82	22.6%	196.78	63.1%	212.01	75.8%
Utility Residual Fuel	38.07	65.27	71.4%	114.23	200.1%	129.46	240.1%
Utility Residual Fuel ($/mmBtu)	2.54	4.36	71.7%	7.64	200.6%	8.66	240.8%
Natural Gas (Dollars per mmBtu)							
Residential	6.54	8.15	24.6%	11.05	68.9%	11.95	82.7%
Industrial	2.76	4.37	58.3%	7.27	163.3%	8.17	196.0%
Utility	2.10	3.71	76.7%	6.61	214.7%	7.51	257.6%
Coal (Dollars per mmBtu)							
Utility	1.33	4.08	206.8%	9.03	578.9%	10.57	694.7%
Electricity (Cents per kWh)							
Residential	8.47	10.27	21.3%	13.51	59.5%	14.52	71.4%
Industrial	4.73	6.61	39.7%	9.99	111.3%	11.05	133.5%

In this analysis, each $100 per metric ton carbon tax converts to:
Petroleum: $11.42 per barrel, $1.97 per mmBtu, or 27.2 cents per gallon;
Gas: $1.66 per mcf or $1.61 per mmBtu;
Coal: $56.60 per short ton or $2.75 per mmBtu.

Calculated from "A Review of the Economic Impacts of AOSIS-Type Proposals to Limit Carbon Dioxide Emissions," pages 3 and 12.

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Attachment 2

Comparison of Results for the U.S. Economy

Study	CO_2 Emissions	Carbon Tax (as reported, per mtc[1])	GDP Losses (from baseline)	GDP Dollar Losses (from current economy[2]; billion 1994 US$)	CO_2 Emission Reduction (from baseline, in million metric tons of carbon)	$GDP Loss/ CO_2 Emission Reduction (1994 $ per mtc)
EPRI (94) Carbon taxes phased-in, initiation in 1996 at $20						
$100 Tax	1.03*1990 in 2000	$100 (92$)	0.7% in 2000	48.26	110.0	438.73
	1.1*1990 in 2010	$100 (92$)	2.3% in 2010	158.60	269.50	588.50
$200 Tax	.99*1990 in 2000	$200 (92$)	0.9% in 2000	62.06	168.37	368.59
	.94*1990 in 2010	$200 (92$)	4.2% in 2010	289.61	490.0	591.04
DRI (92) Carbon emission targets defined at 10-year points; taxes initiated in 1994 at $24 (89$)						
	1.0*1988 in 2000	$120 (89$)	1.4% in 2000	96.54	106.0	910.75
	.9*1988 in 2010	$384 (89$)	4.2% in 2010	315.99	385.0	820.75
	.8*1988 in 2020	$721 (89$)	1.8% in 2020	124.12	618.0	200.84
OECD[3] (92) Taxes initiated in late 1990s						
CRTM	.82*1990 in 2010	$306 (90$)	0.9% in 2010	62.06	526.97	117.77
	.79*1990 in 2020	$294 (90$)	1.3% in 2020	89.64	852.56	105.14
ERM	.84*1990 in 2005	$95 (90$)	0.7% in 2005	48.27	370.06	130.44
	.70*1990 in 2020	$318 (90$)	2.0% in 2020	137.91	728.32	189.35
GREEN	.84*1990 in 2010	$126 (90$)	0.9% in 2010	62.06	507.01	122.40
	.75*1990 in 2020	$202 (90$)	1.1% in 2020	75.85	764.60	99.20
GLOBAL 2100	.86*1990 in 2010	$196 (90$)	1.3% in 2010	89.64	556.90	160.96
	.79*1990 in 2020	$321 (90$)	2.2% in 2020	151.70	858.02	176.80
EMF12[4] (94) Taxes initiated in late 1990s						
CRTM	.8*1990 in 2010	$260 (90$)	1.0% in 2010	68.96	601.02	114.71
DGEM	.8*1990 in 2010	$50 (90$)	1.7% in 2010	117.22	536.63	218.69
GOULDER	.8*1990 in 2010	$50 (90$)	1.2% in 2010	82.75	536.63	154.38
GREEN	.8*1990 in 2010	$170 (90$)	0.9% in 2010	62.06	658.26	94.32
GLOBAL 2100	.8*1990 in 2010	$240 (90$)	1.5% in 2010	103.43	701.19	147.55
GEMINI	.8*1990 in 2010	$330 (90$)	nc	nc	nc	nc
FOSSIL 2	.8*1990 in 2010	$250 (90$)	1.4% in 2010	96.54	658.26	146.72
Global Macro	.8*1990 in 2010	$130 (90$)	nc	nc	nc	nc
ERM	.8*1990 in 2010	$160 (90$)	1.1% in 2010	75.85	536.63	141.51
MWC	.8*1990 in 2010	$160 (90$)	1.1% in 2010	75.85	751.28	101.00

Legend:
1/ mtc: metric tons of carbon
2/ The GDP for the US is for the year 1994 ($6,895.5 billion curent dollars).
3/ CRTM - Carbon Rights Trade Model; ERM - Edmonds-Reilly Model; GREEN - OECD Model
4/ DGEM - Dynamic General Equilibrium Model; MWE - Model of Warming Commitment

ADDENDUM

Please note that a complete copy of the ***Review of the Economic Impacts of AOSIS-Type Proposals to Limit Carbon Dioxide Emissions*** study, can be obtained through the GCC offices at the following address:

1331 Pennsylvania Avenue, NW
Suite 1500, North Tower
Washington, D.C. 20004
Phone: (202) 637-3158
Fax: (202) 638-1043

This study is also available on the Global Climate Coalition's World Wide Web page at:

http://www.worldcorp.com/dc-online/gcc

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Quotes About the Kyoto Protocol And EPA Implementation

From the Congressional Record, July 23, 1998

"I recognize that there should be no imposition of rules or regulations or decrees until and unless the Kyoto Protocol is actually ratified."

Rep. David Obey (D-WI)

"The product that came out of Kyoto was flawed. I have great doubts that it will be ratified."

Rep. Obey

"No one is disputing that (the Administration) should not implement a treaty that has not been ratified.

Rep. Henry Waxman (D-CA)

"There are serious issues and concerns with (Kyoto's) content and its intent...nothing should be done to implement that Protocol until the Senate, if ever, should ratify it and move forward."

Rep. John Tierney (D-MA)

"No rules, no regulations that relate directly to the implementation of the Kyoto Protocols should be done in any direct way prior to ratification of the treaty. The Kyoto Protocols clearly have flaws in them."

Rep. John Olver (D-MA)

The (EPA) is expected to provide education, not advocacy. And if the agency goes across the line into advocacy, it does so at its peril."

Rep. Obey

"We do not let executive branch agencies to adopt regulations to enforce treaties that have not been ratified."

Rep. Waxman

"India, a mass emitter of CO-2, is not going to be bound. Our friends in China have told me that they will never be bound. So that leaves Uncle Sap, the United States, which proposes to be bound by a treaty which is going to cause enormous economic hardship."

Rep. John Dingell (D-MI)

"We should not be trying to implement the Kyoto Protocols if we have not signed them."

Rep. George Brown (D-CA)

"Some of my colleagues this morning talked as if it were clear that we are experiencing global warming. We cannot prove that. We do not know that."

Rep. James Greenwood (R-PA)

"The Kyoto Protocol could not—and should not—be ratified in its current form, and no one should behave as if the treaty has been ratified."

Rep. Sherwood Boehlert (R-NY)

"The United States Congress, namely the Senate, has not given the authority to the Environmental Protection Agency to implement Kyoto and it should not do that without proper authorization."

Rep. Greenwood

1999 Inventory of Industry Voluntary Actions

In 1998, the Global Climate Coalition (GCC) released the first annual assessment of industry's voluntary actions to control and reduce greenhouse gas emissions. Today, several legislative efforts in Congress are targeted at acknowledging and recognizing industry's voluntary efforts.

The Clinton Administration has also acknowledged the importance of voluntary actions, partnerships and initiatives. In all its efforts, the Administration is emphasizing common sense, voluntary proposals that GCC members have advocated for years. Since the ratification of the Framework Convention on Climate Change in 1992, industry has pushed for a wide range of industry-government partnerships, energy efficiency programs and research and development activities that have moved new technologies into the market faster.

Voluntary Action Already a Success

- The nation's **automakers** are producing products powered by natural gas, electricity, flexible fuels and electric-diesel hybrid engines and are currently testing concept vehicles powered by no emission fuel-cell engines.
- **Oil producers** are identifying technology strategies aimed at reducing emissions, as well as actually cutting carbon emissions through process improvements. Process improvements include highly efficient compressors, battery-reinjection systems, steam power from co-generation, more efficient and safer pipeline technology, flare reduction and emissions recovery technologies and dual-action extraction pumps that separate oil and water underground.
- **Electric utilities** will have reduced greenhouse gas emissions by 170 million tons through efficiency and process improvements by 2000. Some of these initiatives at home and abroad include: International Utility Efficiency Partnerships, Electricity for Sustainable Development, technology-based capital venture funds, wind power programs, the Geothermal Heat Pump Consortium, E-Seal (energy-efficient housing), UtiliTree (reforestation/carbon management programs), EV America (electric vehicles) and biomass technology.
- The **steel industry** also expects to reduce emissions through the effective utilization of materials, improved processes and new technologies. They have already reduced energy consumption by 45 percent since 1975.
- **Coal producers** have increased efficiency and reduced emissions through Clean Coal Technology and crosscutting technologies. These efforts include developing technologies that reduce carbon emissions to near zero and sequester additional emissions, improve worker safety and minimize exposure to risk, improve methods of locating reserves with minimal environmental disturbance and maintain and create new markets for clean, recyclable and transportable products. A number of programs aimed at limiting emissions currently exist including coal reburning, pulse combustion, mild gasification and gas reburning, flue gas cleaning and self scrubbing coal.
- Members of the **forest and paper industry** have been the leading advocates of common sense reforestation and sustainable forestry. These methods of forest management have provided a new avenue for carbon sequestration. Led by the American Forest & Paper Association, their efforts have been recognized by the Clinton Administration and key members of the environmental community.
- The **cement industry**, with processes such as continuous casting, has maintained production while reducing energy use by nearly 30 percent.
- **Chemical manufacturers** are promoting a number of cost-effective efforts to reduce emissions and improve efficiency.
- The **aluminum industry** has forged agreements to reduce emissions 40 to 60 percent by 2000.

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More Exciting Voluntary Advances Continue to Appear on the Horizon:

These and other voluntary programs are meeting important environmental challenges without imposing burdensome new rules on the economy. They bring out the best in our people: innovation, cooperation, flexibility and opportunity.

- Automakers are continuing to devote ample resources to cleaner burning fuels, vehicles and powertrains. They are also using lightweight aluminum and other materials to increase mileage and reduce emissions.

- Steel-makers are perfecting an ultra-light steel autobody that will further increase energy efficiency without jeopardizing safety or comfort.

- The coal industry is working with government to find efficient ways to recover energy from the methane in mines, as well as improve its processes.

- Utilities and forest products companies are implementing reforestation programs in the U.S. and abroad to remove millions of tons of carbon dioxide from the atmosphere.

- Oil companies are working on projects around world that are improving efficiency and production, providing better energy options for developed and developing countries.

Government/Industry Voluntary Partner Programs

Climate Wise
Rebuild America
Green Lights
Energy Star
Natural Gas Star
Vision 21
Industries of the Future
Clean Energy
Clean Coal Technology
Partnership for Advanced Technology in Housing (PATH)
Partnership for a New Generation of Vehicles (PNGV)

Advantages of Voluntary Programs vs. Mandates

Voluntary action is the best policy approach given what we know - and don't know - about potential human impacts on the climate.

Implementing the increased regulatory controls called for by the Kyoto Protocol would be costly and would not produce the desired environmental benefit.

Experience shows that voluntary programs provide important benefits to industry participants, including:

- Access to leading-edge information
- Greater return on economic investments
- Increased public awareness and recognition

Government, society and the environment also benefit from voluntary programs.

Voluntary Programs:

- Are flexible policy instruments to achieve environmental objectives in a manner which best suits the economic circumstances of companies

- Encourage industry-led initiatives to address environmental objectives

- Encourage co-operation between industry and government

- Achieve energy and environmental objectives faster than regulations

For more detailed information on individual industry sector programs,
Please Contact Frank Maisano at the Global Climate Coalition, (202) 628-3622

Global Climate Coalition

A voice for business in the global warming debate

CLIMATE ECONOMICS

Climate Economics

Climate Science

Climate Change Primer

What Others Are Saying

Climate Change in the News

Climate Watch Brief Newsletter

Climate Links

GCC News Releases

GCC Studies

GCC Mission

Economic impact of Kyoto reinforced by EIA analysis

"Higher energy prices and the impact of the higher prices on the broader U.S. economy will encourage consumers to reduce energy consumption by between 4 and 18 percent in 2010"

--EIA Report

More doubts about the real cost of the Administration's commitment to the Kyoto Protocol were raised in October 1998 when the Energy Information Administration, the forecasting unit of the U.S. Department of Energy, concluded that the price tag for Americans could be astonomically higher than what the Administration had been telling Congress and the public.

Examples of the impact on the average pocketbook: Increases in electricity costs as high as 86 percent. Gasoline prices 66-cents a gallon higher in the worst case, compared with the Administration's estimate of 5.5 cents. Fuel oil prices as much as 76% higher and natural gas prices rising by as much as 147% over baseline.

Rep. James Sensenbrenner, chairman of the House Science Committee which requested the study, said EIA's report showed the Administration was "sugarcoating harsh realities."

The study, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, examined six cases with different reductions in energy-related carbon emissions. In the case with the highest target carbon emissions are reduced by an average of 122 million metric tons a year relative to the projected baseline emissions between 2008 and 2012, which allows an increase of about 24 percent above 1990 levels. For the lowest target, emissions are reduced on average by 542 million metric tons relative to the baseline, or 7 percent below 1990 levels. Each case implicitly assumes different levels of international actions, offsets, or sinks, but these are not quantified

- **Read the full text of the EIA news release.**

The peril in rosy forecasts

The Clinton Administration publicly offered optimistic assumptions on what it will take to implement the Kyoto Protocol on global warming. In reality, the cost to American families could be 10 times the estimates made by the Administration.

For more on this, click here.

link to Charles River

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Economic Hardship

Nearly every study projects economic harm to the strong U.S. economy if the Kyoto Protocol enters in force.

These are some examples.

DOE Argonne National Lab concluded restrictions on six energy intensive industries – chemicals, petroleum refining, paper, iron and steel, aluminum and cement -- in developed countries, but not in the less developed trading partners, would result in significant adverse impact. The main effect would b to redistribute output, employment and emissions from developed countries to developing countries that are not required to participate.

WEFA, Inc. estimated the Kyoto Protocol will result in ...Total annual output reduction of $300 billion or $2,700 per family ...Loss of more than 2.4 million jobs ...A competitive advantage for advanced developing countries that are not required to participate ...Sharply higher prices for gasoline (65 cents per gallon) and gas and electricity (double).

Charles River Associates estimated the Protocol will cause price increases for natural gas (46%), electricity (23%) and heating oil (45%). Energy consumption will need to be reduced by about 30%.

CONSAD Research estimated that by 2010, more than 3.5 million jobs will be lost, mostly in the aluminum, chemicals, mining, paper, petroleum anc steel industries. CONSAD estimated a loss of $359 billion in Gross Domestic Product. Energy prices would rise 59% causing an $87 billion reduction in disposable income, or $875 per household.

Two Administration studies predict lesser impacts, but they assume circumstances that do not exist, will be very difficult to implement, or inevitably may never occur.

» The DOE five national labs study concluded a national investment in energy efficiency and clean technologies can reduce U.S. emissions and produce energy savings that roughly will equal costs The study concluded emissions reductions can be achieved through technology improvements without increasing the nation's energy bill.

» The President's Council of Economic Advisors Chair, Janet Yellen, said the Kyoto Protocol will hav a "modest" impact on the economy. Using such assumptions as efficient international trading schemes and complete developing country participation, the analysis included increases of only 2-4 cents in gasoline prices, and a cost of only abou $100 per family per year.

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Global Climate Economic Impact Studies

The President's chief economic advisor, Dr. Janet Yellen, has provided very limited supporting information behind her claims of "modes economic impact" from the Kyoto Treaty. Their results rely heavily on the unrealistic assumptions of more than 75% of credits from emissions trading and world-wide developing country participation. Several economic impact studies have been commissioned to date. Following is a summary of many of the most recent studies.

Study: **Charles River Associates**
Date: **March 1999**

Click here, to download the new Charles River Associates study or send an email request for a copy to the Global Climate Coalition.

NOTE: This study is in 'pdf' format and requires Adobe Acrobat to download.

Study: **The Case for a Rational Approach to Climate Change**
Economic Strategy Institute
Date: **November 1998**

The executive summary for this study can be found at
www.econstrat.org/kyotoexecsumm.htm
A copy of the study can also be ordered from the site.

Contact: Sarah Lomas at (202) 289-1288

Global Climate Coalition

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202-682-9161

Media Contact: Frank Maisano

202-628-3622

Study: **Energy Information Administration**
For: **Department of Energy**
Date: **March 1998**

The EIA concluded the Kyoto Treaty would only slow modestly the growth of GHG emissions. CO2 emissions would grow 32% above 1990 levels by 2010 - slightly less than the 44% growth that would occur without the treaty - because of growth of emissions in developing countries like China, Mexico and India. By 2020, emissions would grow by nearly 60% even if the U.S., Europe, Japan and other industrialized nations comply with the Kyoto requirements.

Contact: Jay Hakes or Mary Hutzler at (202) 586-2222

Study: **Argonne National Laboratory**
For: **Department of Energy**
Date: **February 1997**

The Argonne Study concluded that policy restrictions on six energy intensive industries in developed countries, but not their less developed trading partners, would result in significant adverse impact. Furthermore, the study finds emissions would not be reduced significantly. The main effect of the policy would be to redistribute output, employment and emissions from developed countries to developing countries who are not required to participate.

Contact: Harvey Drucker at (630) 252-3804 or Bill Wicker at (202) 586-5806

Study: **WEFA, Inc.**
For: **Industry Groups**
Date: **April 1998**

WEFA estimates that a carbon fee of $265 per metric ton would be required by late next decade to reduce emissions to the Kyoto Protocol's levels, resulting in (1) Total output reduction of 3.2% or $300 billion (in 1992$) or $2700 per family; (2) Loss of more than 2.4 million jobs; (3) a competitive advantage for advanced developing countries that are not required to participate; and (4) Sharply higher gasoline (65 cents per gallon) and gas and electricity prices (double).

Contact: Mary Novak at (781) 221-0340

Study: **CONSAD Research Corporation**
Date: **March 1998**

Based on reductions 3% below 1990 levels, CONSAD estimates that by the year 2010, more then 3.5 million jobs will be lost, mostly in the aluminum, chemicals, mining, paper, petroleum and steel industries. CONSAD estimates a loss of $359 billion in Gross Domestic Product (GDP). Energy prices will rise by 59% causing and $87 billion reduction in disposable income or $875 per household.

Contact: Will Steger at (412) 363-5500

Study: **Standard & Poor's DRI**
For: **Labor Unions**
Date: **August 1998**

This study prepared for labor unions, confirms that even with significant emissions trading and other flexibility mechanisms, the Kyoto Protocol will (1) cost 1.3 to 1.7 million jobs, (2) annual GDP losses of $112 to $178 billion, (3) cause energy prices to rise up to 77% in some sectors, (4) cause household income to decrease 1,021 to 1,403 per family and (5) increase household energy costs by 1,012 to 1,574.

Contact: Michael Buckner, UMWA at (202) 842-7280 or Joe Corcoran at (301) 439-1832

Other Notable Studies:

Charles River Associates, American Automobile Manufacturers Association, November 1997
Contact: David Montgomery at (202) 662-3800

Department of Energy "11 Labs" Report, DOE, (202) 586-5806, October 1997
Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions

Department of Energy "5 Labs" Report, DOE, (202) 586-5806, September 1997
Energy Efficiency and Clean Technologies can produce savings equal to costs

Dr. Stephen S. Fuller, George Mason University Institute of Public Policy; (703) 993-3186, April 1998
Fiscal Impact of Energy Cost Increases on America's Cities

Dr. David Harrison, National Economics Research Associates, Inc.; (617) 621-0444, 1998
Designing and Implementing Effective International Emissions Trading

Dr. Gary Yohe, Wesleyan University -- for the American Council for Capital Formation; (202) 293-5811, June 1997
Climate Change Policy, Risk Prioritization and U.S. Economic Growth

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These studies were summarized by the Global Climate Coalition.
For more information, contact Frank Maisano at (202) 628-3622.

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Charles River Associates analysis of Administratior assumptions about costs

The Clinton Administration has publicly offered optimistic assumptions about it will take to implement the Kyoto Protocol on global warming. In reality, the c to American families could be ten times the estimates made by the Administr because:

- The Administration has been excessively optimistic about the likelihood an international trading system for trading greenhouse gas emissions credits. Dr. Janet Yellen, the chief White House economic advisor, has the cost at between $14 and $23 a ton; economist W. David Montgome Charles River Associates found the cost could be $170 a ton or more. Under that forecast, the cost to the U.S. Gross Domestic Product will be over $100 billion, about ten times the Administration's forecast.

- To achieve the goals of the Kyoto Protocol, the Administration has assu that all coal-fired electric utilities in the United States could be converte natural gas by the year 2010 when the treaty takes hold. Dr. Montgome found this to be unrealistic and questions whether it will be economicall feasible for utility owners to make that rapid a change.

- Replacing coal-fired power plants with natural gas will be an enormousl costly undertaking. There are many reasons – prices of trading credits abroad, lost jobs in the coal industry, limits on natural gas production. T Administration appears to have ignored all these factors.

- To estimate the increased costs on American families of implementing t Kyoto agreement, the Administration measured only part of the costs th which comes directly from rising energy prices. Dr. Yellen's study left th enormous indirect costs to reverberate through the whole economy. According to Dr. Montgomery, costs to American families should be multiplied by two to four times when all factors are considered.

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These flaws in the Administration's own analysis mean that instead of dramatically reducing its own emissions when the Kyoto treaty takes effect, th United States will instead spend billions to purchase emissions credits – mair Russia – to offset our own inability to meet the goals of the Protocol. We will forced to make a massive transfer of wealth to other countries that are actual producing less greenhouse gases that they were in 1990. The alternative of t to meet the ambitious schedule by reducing energy use in the United States i under the Administration's own assumptions, likely to entail costs five times large as the cost of buying permits overseas -- and ten times as much under more realistic assumptions made by Dr. Montgomery.

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DOE's forecasting unit says

Higher energy prices, cuts in fuel use may be needed to comply with the Kyoto Protocol

"Higher energy prices and the impact of the higher prices on the broader U.S. economy will encourage consumers to reduce energy consumption by between 4 and 18 percent in 2010"
--EIA Report

Following is the text of an EIA news release:
WASHINGTON, Oct. 9 - Significant increases in energy prices may be required for the United States to meet the reductions in greenhouse gas emissions agreed to in December 1997, according to a report released today by the Energy Information Administration (EIA).

This study, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, was undertaken at the request of the United States House of Representatives Committee on Science to analyze the impacts of the Kyoto Protocol on U.S. energy markets and the economy.

EIA examined six cases with different reductions in energy-related carbon emissions. In the case with the highest target, carbon emissions are reduced by an average of 122 million metric tons a year relative to the projected baseline emissions between 2008 and 2012, which allows an increase of about 24 percent above 1990 levels. For the lowest target, emissions are reduced on average by 542 million metric tons relative to the baseline, or 7 percent below 1990 levels. Each case implicitly assumes different levels of international actions, offsets, or sinks, but these are not quantified. To reduce energy-related carbon emissions, EIA added a carbon price to the price of delivered energy fuels based on their carbon content. EIA concludes:

- The costs of the Kyoto Protocol will depend on the amount of permits that can be purchased internationally, on projects to reduce emissions or develop sinks in other countries, and on domestic actions to reduce other gases and develop sinks. These actions may reduce compliance costs by offsetting reductions in energy-related carbon emissions.
- The carbon price required to reduce U.S. energy-related carbon emissions ranges from $67 to $348 per metric ton in 2010 (1996 dollars). In the more stringent reduction cases, the carbon price will decline by 2020 as more efficient and lower-carbon technologies become economically available and penetrate later in the forecast horizon. Due to the carbon price, the average price of gasoline could be between $0.14 and $0.66 per gallon higher in 2010 than it would be otherwise, and electricity prices could increase by 20 to 86 percent.

Economic Hardship

Nearly every study projects economic harm to the strong U.S. economy if the Kyoto Protocol enters into force. These are some examples.

DOE Argonne National Lab concluded policy restrictions on six energy intensive industries – chemicals, petroleum refining, paper, iron and steel, aluminum and cement -- in developed countries, but not in their less developed trading partners, would result in significant adverse impact. The main effect would be

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to redistribute output, employment and emissions from developed countries to developing countries that are not required to participate.

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Two Administration studies predict lesser impacts, but they assume circumstances that do not exist, will be very difficult to implement, or inevitably may never occur.

» The DOE five national labs study concluded a national investment in energy efficiency and clean technologies can reduce U.S. emissions and produce energy savings that roughly will equal costs. The study concluded emissions reductions can be achieved through technology

- Higher energy prices and the impact of the higher prices on the broader U.S. economy will encourage consumers to reduce energy consumption by between 4 and 18 percent in 2010, relative to the baseline, by reducing the demand for energy services and purchasing more efficient equipment. However, energy consumption will increase between 2010 and 2020 as the economy grows and carbon prices decline. Shifts from more to less carbon-intensive fuels will also occur.
- Because coal is the most carbon-intensive of the fossil fuels, the price of coal will rise dramatically -- between 153 and 800 percent in 2010 relative to baseline projections, and coal use will be reduced by between 18 and 77 percent, particularly for electricity generation. Electricity generation from coal may be reduced to between 2 percent and 74 percent of today's level by 2020.
- Electricity generation by coal will be replaced by natural gas and renewables and also by the continued operation of many existing nuclear plants. Increases in natural gas consumption for electricity generation will more than offset reductions in consumption by other consumers. Natural gas consumption may increase between 2 and 12 percent in 2010 over the baseline.
- Electricity generation by renewable sources will increase as more technologies become economic with higher fossil fuel prices. Renewables could capture between 11 and 22 percent of the generation market by 2020, relative to 9 percent in the baseline, with more than half supplied by renewables other than hydropower. Major increases are expected in wind and biomass gasification and also in geothermal generation.
- Nuclear generation's decline will slow as it becomes economic under higher carbon prices to extend the operating life of existing plants rather than retire them, raising nuclear generation between 8 and 20 percent in 2010, compared to the baseline.
- Petroleum consumption will be lower than it would be without carbon reductions but will likely remain above current levels because most petroleum is used for transportation where there are limited economic options to shift to less carbon-intensive fuels. Gasoline consumption could be between 3 and 18 percent lower in 2010 compared to the baseline, and jet fuel consumption lower by between 1 and 16 percent.
- When energy costs rise, other factors of production including labor and capital become relatively less expensive. Energy price increases encourage adjustments in which labor and capital are substituted for more expensive energy. In the process, some economic potential

improvements without increasing the nation's energy bill.

» The President's Council of Economic Advisors Chair, Janet Yellen, said the Kyoto Protocol will have a "modest" impact on the economy. Using such assumptions as efficient international trading schemes and complete developing country participation, the analysis included increases of only 2-4 cents in gasoline prices, and a cost of only about $100 per family per year.

is lost which could reduce the "potential" GDP from a growth rate of 2.0 percent per year between 2005 and 2010 in the baseline to 1.9 percent a year.

- Recycling carbon revenues back to consumers will offset some of the negative impacts on the economy. In the baseline, the actual gross domestic product (GDP) grows at an average rate of 2.0 percent a year between 2005 and 2010. As a carbon price is introduced, the average growth could be reduced to 1.6 percent a year, assuming a social security tax rebate, or to 1.2 percent a year, assuming a personal income tax rebate. As carbon prices decline and the economy adjusts, GDP rebounds and the average growth rate from 2005 and 2020 is only slightly less than in the baseline.
- The loss in GDP, plus the funds used to purchase permits internationally, represents the total cost to the economy. Over the period 2008 to 2012, the annual average total cost ranges from $77 billion (1992 dollars) to $338 billion, depending on the level of carbon reductions and the recycling assumptions. This cost is relative to a total economy of $7 trillion in 1996, growing to about $9.5 trillion in 2010, and about $11 trillion in 2020 (1992 dollars).

EIA also analyzed cases with alternative assumptions about higher and lower economic growth, faster and slower technology change, and the construction of new nuclear generation plants.

Climate Change
and
Economic Impacts Analysis

WHAT IS CLIMATE CHANGE?

Beginning in the 1980s concern arose about increases in emissions of greenhouse gases (carbon dioxide and methane are two examples) resulting from human activities and whether increased concentrations would have an adverse effect on the global climate.

Over the past century average global temperatures have risen about half a degree, but scientists cannot say whether the increase has been caused by increases in human-generated greenhouse gases or by natural climatic variability.

Computer models have been developed that attempt to predict future climate changes, but they are widely recognized as inadequate, even though they are being improved.

WHAT IS BEING DONE ABOUT CLIMATE CHANGE?

The United Nations General Assembly created the Intergovernmental Negotiating Committee in 1990 to negotiate a climate change treaty—the Framework Convention on Climate Change—whose aim was to prevent dangerous human interference with the climate by reducing emissions of greenhouse gases.

In 1992 the FCCC was opened for signing at the Earth Summit in Rio de Janeiro. It entered into force in early 1993 and since then has been ratified by 160 countries.

WHAT IS THE CONFERENCE OF PARTIES?

The Conference of Parties to the FCCC was created to administer the implementation of the FCCC. At its first meeting in Berlin in 1995, the COP called for strengthening the FCCC by requiring industrialized countries to commit to emissions reductions after the year 2000.

In July 1996 the COP will hold is second meeting in Geneva to continue the negotiating process, which is expected to culminate with an agreement at the third COP in Japan in mid-to-late 1997.

WHAT IS THE INTERNATIONAL IMPACT ASSESSMENT MODEL?

The IIAM is a computerized model for analyzing the impacts of climate change policies on any country of the world. It is presently configured with data for 80 countries. It uses a state-of-the-art trade model to estimate how various climate proposals would affect broad trade patterns in the world economy. It then uses these results to drive a single-country applied general equilibrium model. This second model forecasts the impacts of climate change policies on the selected country.

HOW DOES THE MODEL WORK?

The user can choose from a list of proposals representing the major initiatives being considered in the negotiating process. Three baseline scenarios for economic growth and carbon emissions, consistent with the high (IS92f), middle (IS92a), and low-emission scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) are available as starting points. The user also specifies key assumptions about how economic changes caused by climate policies would affect world trade. A full applied general equilibrium model of the selected country is then run and results reported and displayed to the user. A variety of assumption affecting the magnitude of impacts can be manipulated to explore the range of possible results.

WHAT ARE THE BENEFITS OF THE MODEL?

The IIAM allows interactive analysis and discussion of alternative climate change mitigation proposals and their effects on individual countries. It can accommodate a wide range of views on future economic conditions and the ways in which different economies could respond to those conditions that might result from the current negotiations on changes to the Framework Convention on Climate Change. The impacts that can be estimated by the IIAM include Gross Domestic Product, Unemployment, Terms of Trade, Leakage of Carbon Emissions, Implicit Carbon Tax, Real Wage Rates, Exports and Imports, and Oil Prices.

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Climate Change Is a Congressional Issue

JUNE 1996

International activity related to climate change has accelerated since President Bush signed the Framework Convention on Climate Change in Rio de Janeiro in 1992. This contrasts with the ebbs and flows of media attention and relative lack of public awareness in the United States. A new United Nations-sponsored climate change bureaucracy is now engaged in negotiations involving more than 160 nations. These negotiations are anticipated to be completed by late 1997 and could produce an agreement placing the United States at a significant economic and competitive disadvantage, while having no substantial effect on limiting the risk of climate change.

Congressional oversight is critical to ensure that the Administration vigorously holds the line against any premature and precipitous climate change agreements that threaten U.S. economic and competitive interests.

The Berlin Mandate Process

The latest round of international climate change negotiations, known as the Berlin Mandate Process, began in August 1995. These negotiations are expected to strengthen the Climate Change Convention by adding new policies and measures -- including additional energy taxes and caps on national emissions -- to reduce greenhouse gas emissions after the year 2000. The Berlin Mandate Process could take fewer than 18 months to complete, so time is of the essence. Moreover, many of the principles incorporated into the negotiating process would skew the outcome against U.S. economic interests.

- **Developing Nations Are Exempted:** The climate change issue is global and can be addressed only on a broad international basis. The Clinton Administration continuously has stressed a global perspective. U.S. climate negotiators, however, agreed to the Berlin mandate language that exempts all developing nations, including the most advanced nations such as South Korea and Singapore, and nations such as China and India that will be the largest individual sources of emissions in the future. "Exempted" countries are invited to the negotiating table, where they will be able to protect their exemption and help determine how much more should be done by developed nations, such as the United States, to reduce their emissions well into the next century. Ironically, the "exempted" countries, as a group, will produce the majority of greenhouse emissions in future years.
- **Targets and Timetable Approach Hurts the United States:** Serious proposals being considered in the Berlin mandate negotiations would require legally binding targets and timetables to reduce carbon dioxide emissions 15-20 percent below 1990 levels by 2005 or 2010. If ratified, mandatory targets and timetables would drop U.S. Gross Domestic Product 2-3 percent (about $140-$200 billion in today's economy) and cost

600,000 jobs annually, according to DRI/McGraw Hill estimates. Moreover, targets and timetables would impose a disproportionate economic burden on the U.S. economy, due largely to the combined effect of continued economic growth and future population increases. Countries supporting target and timetable proposals do not face these com bined factors.

What Congress Can Do

The Administration must be held accountable in the Berlin Mandate Process for ensuring that any agreement: (1) includes appropriate commitments from all nations involved in the negotiations, and (2) keeps the United States on an even footing with our t rading partners, as President Clinton assured last year. This can be achieved if Congress --

- holds major oversight hearings before the ministerial-level climate change negotiations scheduled for July 1996. This second meeting of the Conference of the Parties (countries that have ratified the Climate Convention) will address scientific and e conomic analyses and assessment activities and U.S. policies and positions on the new commitments being negotiated;
- evaluates information contained in the wide range of economic studies that have been conducted to date, and seeks information regarding economic studies now being conducted by the Administration;
- requires the U.S position in Berlin mandate negotiations to be based on full participation of appropriate federal agencies with expertise in economic, trade and employment policies;
- requires that the United States analyze and assess the job, trade and competitive impacts of specific policies, measures and timetables proposed;
- requires that the secretary of state certify to Congress that any protocol, amendment or other legal instrument resulting from the climate negotiations and submitted to the Senate for ratification (1) was developed in a transparent manner and analyze d for economic and environmental impacts; (2) ensures that the cost of implementation will not adversely affect the industrial competitiveness of the United States, and (3) states that implementation will be achieved by the United States without the need for new regulatory requirements, standards, taxes or fees;
- requires that U.S. negotiators discuss policy decisions with and seek the advice and counsel of non-government organizations, including U.S. business, labor and the environmental community; and
- considers a bipartisan resolution or legislation expressing these views.

For more information on the Berlin Mandate Process, possible legislation or other issues related to the science and economics of climate change, please contact the Global Climate Coalition at (202) 637-3158.

Talking points for GCC talking points (Straw-Man) paper

Audience: Friendly Repub. and Dem. staff aware of climate change issue but not briefed on AGBM process

Mission: Establish predicate that climate change is a congressional issue. Believe we need to

do this before we can pursue a legislative strategy.

Objective: Create a straw man to focus thinking and discussion.

Key Issue: When do we go to the Hill? Still need a hook Maybe upcoming AGBM meeting will provide it

Summarize paper

FACTS ON CLIMATE CHANGE

HIGHLIGHTS FROM THE 1995 SECOND ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE*

Introduction

What follows are direct quotations from the published version (Cambridge University Press, 1996) of the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). The Second Assessment Report (SAR) includes the product of three working groups, each having gone through its own clearance and approval process following many months of research and deliberations. The quotations have been collected under subject headings to make it easier for the reader to track specific topics. It should be noted that many of these citations have been altered substantially from the original version as approved by the IPCC Rome Plenary meeting in December, 1995. The cumulative impact of the alterations diminish the high level of uncertainty expressed in the original text.

HUMAN IMPACTS ON CLIMATE

" 'Detection of change' is the process of demonstrating that an observed change in climate is highly unusual in a statistical sense. This requires distinguishing any human effects on climate from the background 'noise' of climate fluctuations that are entirely natural in origin. Such natural fluctuations can be either purely internal or externally driven, for example by changes in solar variability or the volcanic dust loading of the atmosphere." (WGI FSM, Summary, Chapter 8, p. 411)

"Although these global mean results suggest that there is some anthropogenic component in the observed temperature record, **they cannot be considered as compelling evidence of a clear cause-and-effect link between anthropogenic forcing and changes in the Earth's surface temperature.** It is difficult to achieve attribution of all or part of a climate change to a specific cause or causes using global mean changes only." (WGI FSM, Summary, Chapter 8, p. 411)

"In summary, **'detection of change'** is the process of demonstrating that an observed change in climate is highly unusual in a statistical sense, but **does not provide a reason for the change. 'Attribution' is the process of establishing cause and effect**, i.e., that changes in anthropogenic emissions are required in order to explain satisfactorily the observed change in climate." (WGI FSM, section 8.1.1, p. 413)

"Statements regarding the detection and attribution of an anthropogenic effect on climate are inherently probabilistic in nature. They do not have simply 'yes-or-no' answers." (WGI FSM, section 8.1.1, p. 413)

"Most of the recent work in the detection field has been this type of 'Stage 1' study. A number of these investigations (both pre- and post-IPCC (1990)) have claimed the detection of a highly significant change in observed global mean temperature over the last 100 years. **However, none of these studies has convincingly demonstrated that this change can be uniquely attributed to anthropogenic influences."** (WGI FSM, section 8.1.2.1, p. 414)

"Defining an anthropogenic climate change signal is only one part of the detection problem. **The climate state of the Earth is always changing in both space and time for reasons that have nothing to do with** anthropogenic forcing. The space-time structure of this natural variability must be estimated in order to decide whether the changes that have been observed in the past or that will be observed over the next 10-20 years are due primarily to human activities or natural causes. **This spectrum of natural variability is a critical element** in the significance-testing portion of any practical detection or attribution scheme." (WGI FSM, section 8.3, p. 418)

"Claims of non-significance of the global warming trend have also been made by Ghil and Vautard (1991) using Singular Spectrum Analysis (SSA)." (WGI FSM, section 8.4.1.1, p. 422)

"Any such attribution-related conclusions, however, rest heavily on the reliability of our estimates of both century time-scale natural variability and the magnitude of the observed global mean warming trend. At best, therefore, trend significance **can only provide circumstantial support** for the existence of an anthropogenic component to climate change." (WGI FSM, section 8.4.1.1, p. 423)

"In summary, such studies offer support for a ΔT_{2X} value similar to that obtained by GCMs, *and suggest that human activities have had a measurable impact on global climate,* but ***they cannot establish a unique link between anthropogenic forcing changes and climate change."*** (WGI FSM, section 8.4.1.3, p. 424)

"This result does not mean that the regional-scale features of a model-predicted greenhouse warming pattern have been detected and convincingly attributed to increases in atmospheric CO2." (WGI FSM, section 8.4.2.1, p. 426)

"In essence, this result says that the most recent (20-30 year) trends in global mean temperature are significantly different from the estimated level of background noise. As noted for Stage 1 studies, this does not resolve the attribution issue." (WGI FSM, section 8.4.2.1, p. 426)

"In summary, attempts to detect a CO2-only signal in the climate system have given ambiguous results." (WGI FSM, section 8.4.2.1, p. 430).

"To date, pattern-based studies **have not been able to quantify the magnitude** of a greenhouse gas or aerosol effect on climate. (WGI FSM, section 8.4.2.3, p. 434)

"The best available evidence suggests that observed near-surface air temperature has increased by 0.3 C to 0.6 C in the last 100 years (Chapter 3). This result is in accord with both simple and more complex model predictions....This **agreement does not,** however, **constitute identification of an anthropogenic effect on climate and may be serendipitous**. The degree of consistency between modeled and observed global mean, annually averaged temperature changes depends on a variety of factors. These include the model's climate sensitivity, the magnitude and sign of simulated multi-decadal variability (and or climate drift), oceanic thermal inertia, and the relative strength of the positive forcing due to greenhouse gases and the negative forcing due to aerosols. **It is certainly feasible that qualitative agreement could be due to compensating errors,** such as a climate sensitivity that is too high being partially offset by cooling due to a residual drift, or by an overestimated aerosol effect. " (WGI FSM, section 8.5.2, p. 437)

"Because humans have influenced mountain ecosystems in many different ways throughout history, anthropogenic impacts generally cannot be dissociated from climate change impacts. **Climatic influences are often obscured by the impact of change in land use.**" (WGII FSM, section 5.2.4, p. 202)

"Some of the **impacts** of global climate change are **beneficial**, some are **neutral**, and some are **adverse**." (WGII FSM, section 8.5.3, p. 284)

"Regarding specific industry emissions, **energy-intensive industries** such as chemicals, cement, and steel **have shown substantial improvements in energy efficiency** during the past 20 years...." (WGII FSM, Executive Summary, Chapter 20.0, p. 651)

"...**the general trend for GHG emissions from fuel combustion** in the manufacturing sector of industrial nations in the past 2 decades has been downward (Torvanger, 1991; Figure 20-1). The overall decrease from 1973 to 1991 was about 15%." (WGII FSM, section 20.2.3.1, p. 656)

SCIENTIFIC UNCERTAINTY

"GCM estimates seldom extent beyond about 100 years, due to the uncertainties attached to such long-term projections....**In many economic assessments, on the other hand, projections may not be reliable for more than a few years ahead.**" (WGII FSM, section 26.6.2.1, p. 828).

"**The development of a baseline describing conditions without climate change is crucial**, for it is this baseline against which all projected impacts are measured." (WGII FSM, section 26.6.3, p. 829).

"**No method yet exists of providing confident predictions of future climate.** Instead, it is customary to specify a number of plausible future climates." (WGII FSM, section 26.6.5, p. 829)

"However, it is clear **that the period of instrumental record began during one of the cooler periods of the past millennium**". (WGI FSM, section 3.6.4, p. 179).

"All the forms of data used to examine climate change and variability suffer from problems of quality and consistency, so conclusions reached on the basis of just one form of data must always be somewhat suspect." (WGI FSM, section 3.7, p. 179)

"**...current data and systems are inadequate for the complete description of climate change.** Virtually every monitoring system and data set requires better data quality and continuity. New monitoring systems, as well as improvements on current systems and studies to reduce quality problems from historical data, are required." (WGI FSM, section 3.7, p. 180)

"**Historical temperature data are plagued by inhomogeneities** from changes in instrumentation, exposure, site-changes, and time-of-observation bias." (WGI FSM, section 3.7, p. 181)

"Conclusive detection and attribution of global climate change will require an ongoing homogenous, globally representative climate record. This needs to be given high priority in the design and maintenance of meteorological and oceanographic monitoring systems." (WGI FSM, section 3.7, p. 181).

"Future population and economic growth are uncertain; future greenhouse gas emissions, given population and economic activity, are uncertain; future greenhouse gas concentrations, given emissions, are uncertain; future climate, given atmospheric concentrations of greenhouse gases, is uncertain; future physical impacts of climate change are uncertain; and the future valuation of the physical impacts attributable to climate change is uncertain." (WGIII, FSM, Section 10.3, p. 379)

"**It is recognised that many remaining uncertainties need to be reduced** in each of the above-named disciplines which is why IPCC projections and scenarios are often expressed with upper and lower limits. These ranges are based on the collective judgment of the IPCC authors and the reviewers of each chapter, but it may be appropriate in the future to draw on formal methods from the discipline of decision analysis to achieve more consistency..." (WGI FSM, section 11.1, p. 523)

"**The simulation of clouds** and their seasonal variation **remains a major source of uncertainty** in atmospheric models." (WGI FSM, section 5.3.1.1.7, p. 253)

"Although the concentration of methane in the atmosphere is well documented, the magnitudes of its sources and sinks and the processes involved are **poorly understood.**" (WGI FSM, section 10.3.5.1, p. 506)

"**The single largest uncertainty in determining the climate sensitivity to either natural or anthropogenic changes are clouds and their effects on radiation and their role in the hydrological cycle.** Although there are many important unresolved issues relating to the basic physics of cloud-radiation interactions and their parameterization in climate models, **even perfect parametrizations of radiation and cloud optical properties cannot produce realistic radiative fluxes and heating rates unless they are provided with a realistic distribution of cloudiness.** At the present time, weaknesses in the parametrization of cloud formation and dissipation are probably the main impediment to improvements in the simulation of cloud effects on climate." (WGI FSM, section 6.7.1.1, p. 345)

Extreme Weather Events & Climate Variability

"Overall, **there is no evidence that extreme weather events, or climate variability, has increased, in a global sense**, through the 20th century, although data and analyses are poor and not comprehensive. On regional scales there is clear evidence of changes in some extremes and climate variability indicators. Some of these changes have been toward greater variability; some have been toward lower variability." (WGI FSM, section 3.5.4, p. 173)

"In the few analyses available, **there is little agreement between models on changes in storminess that might occur in a warmer world.** Conclusions regarding extreme storm events are obviously even more uncertain." (WGI FSM, Summary, Chapter 6, p. 290)

"**There is little or no evidence of consistent increases in such events**. For instance, Ostby (1993) found no evidence of increased occurrence of strong or violent tornadoes in the USA, although the numbers of reports of less severe tornadoes appears to have increased, perhaps due to increased population, eagerness in reporting, or improved reporting procedures. Grazulis (1993) reported a drop in damaging tornadoes in the 1980s over the USA." (WGI FSM, section 3.5.3.5, p. 172)

"**In summary, temperature shows no consistent, global pattern of change in variability**. Regional changes have occurred, but even these differ with the time-scale considered." (WGI FSM, section 3.5.2, p. 168)

"A study of floods in Sweden (Lindstrom, 1993) found **no convincing evidence** of trends through the 20th century, although the 1980s had larger floods than usual and the 1970s had few high floods." (WGI FSM, section 3.5.2.2, p. 169)

"Atlantic hurricane (tropical cyclone) activity over the period 1970 to 1987 was **less than half** that in the period 1947 to 1969 (Gray, 1990)." (WGI FSM, section 3.5.3.1, p. 169)

"Figure 3.19 shows the mean maximum sustained wind speed attained each year in Atlantic hurricanes (Landsea et al., 1996). **Mean maximum wind speed appears to have decreased**." (WGI FSM, section 3.5.3.1, p. 170).

"In summary, the evidence on changes in extra-tropical synoptic systems is **inconclusive**. There is no clear evidence of any uniform increase." (WGI FSM, section 3.5.3.2, p. 171).

"There are grounds for believing that **intense tropical cyclone activity has decreased** in the North Atlantic,...." (WGI FSM, section 3.5.4, p. 173).

"Widespread significant changes in extreme high temperature events have not been observed, even in areas where the mean temperatures have increased." (WGI FSM, section 3.5.4, p. 173).

"It is **presently uncertain** whether the frequency and severity of tropical cyclones will increase due to climate change." (WGII FSM, Executive Summary, Chapter 8, p. 269)

"**It is not possible to say** if the intensity, frequency, or locations of cyclone occurrence would change in a warmer world (High Confidence)." (WGII FSM, Executive Summary, Chapter 9, p. 291)

"At present, there is **no evidence of any systematic shift in storm tracks**." (WGII FSM, section 9.3.2, p. 298)

"In short, **it is not yet possible to say** whether the intensity or frequency of tropical cyclones (or ENSO) would increase or the areas of occurrence would shift in a warmer world." (WGII FSM, section 9.3.2, p. 298).

"Despite the often repeated assertion that climate variability could increase in a warmer world, **there is little evidence from climate models to support this notion** (Gates et al., 1992)." (WGII FSM, section 9.3.2, p. 298)

"Although there is uncertainty, **the extent of damage caused by great windstorm catastrophes has expanded in recent years. The concentrations of people living in high-risk coastal regions must be considered the main reason for this alarming trend**....It is therefore quite possible to get a scientific assessment of low injury to an ecosystem combined with high economic loss value, especially given that the value of waterfront real estate is normally high (see also chapter 17)." (WGII FSM, section 8.3.1.6, p. 278)

Potential Health Impacts

"Of course, **it is not possible to attribute particular, isolated events to a change in climate or weather pattern**; other plausible explanations exist for each of them, and a number of different factors may combine to produce each event." (WGII FSM, section 18.7, p. 580)

"**Improved primary health care for vulnerable populations could play a significant role in reducing a range of health impacts**, including some vector-borne and other communicable diseases, and the effects of extreme events." (WGII FSM, section 18.5, p. 579)

"A range of **adaptive mechanisms for offsetting the potential human-health effects of global warming lie in improving certain aspects of health services and other public services** that settlements provide in any case. (World Bank, 1993). Improved sanitation and water treatment both reduce the spread of waterborne diseases and may provide a measure of safeguard against importing exotic enteric waterborne diseases such as cholera...Finally, disease surveillance could be strengthened and integrated with other environmental monitoring to design early warning systems; develop early, environmentally sound public health interventions; and develop anticipatory societal policies to reduce the risk of outbreaks and subsequent spread of epidemics." (WGII FSM, section 12.5.6, p. 420)

"Adaptive options to minimize health impacts include improved and extended medical care services; environmental management; disaster preparedness; protective technology (housing, air conditioning, water purification, vaccination, etc.); public education directed at personal behaviors; and appropriate professional and research training." (WGII FSM, Executive Summary, Chapter 18, p. 565)

"In the already endemic areas, especially in the subtropics, malaria may increase (although in some hot climates, **further temperature increases may shorten the life span of mosquitoes, and local malaria transmission would then decrease**)." (WGII FSM, section 18.3.1.1, p. 573)

POLICY IMPLICATIONS

"Local environmental and socioeconomic situations are changing rapidly for reasons other than climate change. Worldwide, population growth, industrialization, urbanization, poverty, technological changes, and government policy could overwhelm any effects of climate change." (WGII FSM, section 12.0, p. 401)

"In applying CBA [cost benefit analysis] to the global climate change problem, and in particular to the evaluation of alternative policies to optimize net benefits, **several major sources of uncertainty** need to be considered:

1. Uncertainty about the actual **rates of emission**....
2. Uncertainty about the **costs of emissions reduction**....
3. Uncertainty about scientific linkages.... As already noted in Section 5.3, there exists a **chain of scientific uncertainty** (see Figure 5.3). The extent to which these uncertainties can be resolved by future research is itself subject to uncertainty....
4. Uncertainty in **valuing the costs and benefits of the physical impacts**....
5. Uncertainty about the **assumptions underlying policy options**....
6. Uncertainty about the **effectiveness of policies**....
7. Uncertainty about **joint benefits and costs**...." (WGIII, FSM, section 5.5.1, p. 161)

"**A well-chosen portfolio of climate change investments will yield greater benefit for a given cost than any one option undertaken by itself.** For an individual country, the issue is how to choose the portfolio of policy measures best suited to its circumstances and to adjust the portfolio over time in response to new developments. Governments will be making climate change decisions for several decades at least. This means that they will have many opportunities to adjust the size (total resources) and mix (choice of measures) of their portfolios of responses. Portfolios may differ from country to country." (WGIII, FSM, section 1.3.1.1, p. 24).

"As a policy question, global climate is sometimes posed as a choice between a) doing nothing at all or b) committing to an all-out effort. Given the large current uncertainties about the costs and benefits of greenhouse mitigation, this is the wrong way to frame the issue.... **A more useful formulation is:** 'Given current knowledge and concerns, **what actions should we take over the next one or two decades to position ourselves to act on new information that will become available?**" (WGIII, FSM, section 1.3.2, p. 26)

"Enforcing compliance with international legal agreements presents **a number of legal and political problems**. Many states resist compulsory use of the judicial process; **this provides an incentive for free riding**." (WGIII, FSM, section 1.3.4.3, p. 30).

"Because of the large uncertainties and differences between parties, there may be no 'globally' optimal climate change strategy.....Climate actions under the FCCC should be sequential; countries should implement a portfolio of mitigation, adaptation, and research measures; and they should adjust this portfolio continuously in response to new knowledge. The value of better information is potentially very large." (WGIII, FSM, Chapter 2, Summary Section, p. 57)

"Because of **decision uncertainties** and the **differing interests and values** of international parties, there is **no unique globally optimum response** to climate change." (WGIII, FSM, section 2.4, p. 69).

"The analysis suggests that the emissions time path may be as important as the concentration level itself in determining the costs of emission abatement. **Time is needed both for an economical turnover of the existing capital stock and to develop and deploy low-cost carbon-free alternatives. The most cost-effective emission time-paths are those which** provide the greatest flexibility in managing the transition away from fossil fuels. Shifting emission reductions into the outer years can reduce costs substantially while preserving both the concentration target and the date at which the target is achieved." (WGIII, FSM section 9.2.5.1.6, p. 343)

"A major difficulty in determining the impact of climate change on human habitat is the fact that **many other factors, largely independent of climate change, are also important. In many cases, these others factors are far more important than climate change in terms of the risk they pose for human settlements.** These non-climate factors will also increase the vulnerability of some regions to climate change. The most important of these factors include population growth, urbanization and industrialization, technology choices, and government policies. Other social factors, such as cultural clashes and warfare, also play a role." (WGII FSM, section 12.2, p. 403)

"Because of the high cost of being wrong in either direction, the **value of information** about climate change is likely to be great." (WGIII, FSM, section 1.3.2, p. 26)

ECONOMIC ASSESSMENTS

"Apart from the scientific uncertainty of climate change, there are additional uncertainties associated with

(a) **Limited knowledge of regional and local impacts**
(b) **Difficulties in measuring the economic value of impacts**, even where the impacts are known. *This is particularly the case for nonmarket impacts and the impacts in developing countries*
(c) **Difficulties in predicting future technological and socioeconomic developments**
(d) The possibility of catastrophic events and surprises

This uncertainty must be emphasized when interpreting the social cost figures in this chapter." (WGIII, FSM, section 6.8, p. 218)

"**No scientific consensus exists** on the framework for deciding the burden of financing mitigation and adaptation." (WGIII, FSM, section 1.3.4.2, p. 29)

"**Our knowledge about how anthropogenic emissions of greenhouse gases affect global temperature, what kind of effects a change in global temperature may have, and how efforts to mitigate climate change may work is clearly restricted**. How different greenhouse gases react in the atmosphere is not fully understood, and even if exact predictions of the average increase in global temperature could be made, the different regional effects of these increases will be exceedingly difficult to foresee. There is also considerable uncertainty about the economic and social effects of abatement measures, which are decisive for determining their associated costs and benefits." (WGIII, FSM, *section* 5.5.1, p. 159)

"To change the target for climate policy from emissions to atmospheric concentrations indicates a radically different cost effectiveness strategy. A stabilization of CO_2 emissions at present levels is not sufficient to stabilize the atmospheric concentrations. Richels and Edmonds (1995) have compared the costs of reaching a particular concentration by 2100 for a variety of strategies. They show that a given concentration in 2100 could be achieved at a considerably lower cost if emissions were not stabilized immediately. The reason is that **a more gradual reduction of emissions would avoid the economic shock that would follow a sudden stabilization**, enable future advanced technologies to be utilized to a larger extent, and facilitate the postponement of sizable abatement costs." (WGIII, FSM, section 5.2, p. 150)

"The level of sophistication of climate change damage analysis is comparatively low. **Damage estimates are generally tentative and based on several simplifying and often controversial assumptions**. The degree of uncertainty is correspondingly high, with respect to both physical impacts and their consequences for social welfare." (WGIII, FSM, section 6.1, p. 184)

"**Attempts to quantify long-term damage are rare and highly speculative.**" (WGIII, FSM, section 6.3, p. 207)

"The study finds that the **removal of energy subsidies has a major impact** in reducing energy consumption and carbon emissions." (WGIII, FSM, section 9.2.4.1.2, p. 326)

"An immediate response to the greenhouse problem is to **invest in research and development to reduce greenhouse uncertainties** and subsequently to **provide new information to decision makers.**" (WGIII, FSM, section 11.1.2, p. 402)

"Many researchers argue that **unilateral action by the U.S. or by OECD countries are likely to be less effective than global action,** and that unilateral actions are likely to exaggerate the impact on GDP." (WGIII, FSM, section 5.4.3, p. 156)

"Despite the current limitations of these various techniques, modern **CBA** (broadly defined) **remains the best framework** for identifying the essential questions that policy makers must face when dealing with climate change." (WGIII, FSM, section 5.6, p. 170)

"**Climate change presents the analyst with a set of formidable complications: large uncertainties,** the potential for **irreversible damages or costs,** a very **long planning horizon,** long time lags between emissions and effects, a global scope, wide regional variations, and multiple greenhouse gases of concern." (WGIII, FSM, section 1.2, p. 22)

General Circulation Models

"**Current models are simplistic and provide poor representations of dynamic processes.** The effect of climate change adaptation in particular is **poorly understood.**" (WGIII, FSM, Chapter 6, Summary section, p. 183)

"As a result, **GCMs are currently unable to reproduce accurately even the seasonal pattern of present-day climate observed at a regional scale.** Thus GCM outputs represent, at best, broad-scale sets of possible future climatic conditions and **should not be regarded as predictions.**" (WGII FSM section 26.6.5.3, p. 830)

"Model validation is one of the most important components in our efforts to predict future global climate change. Although model performance has generally improved over the last decade, both coupled and uncoupled models still show systematic errors in their representation of the mean state and variability statistics of current climate (see Chapter 5, and also Gates et al., 1990, 1992). Such errors reduce our confidence in the capability of AOGCMs to predict anthropogenic change." (WGI FSM, section 8.2.1, p. 416).

"Realistic simulation of the present climate is probably a necessary, but not sufficient condition to ensure successful simulation of future climate. To be confident that a model has predictive skill on time-scales of decades or longer, we would also have to be sure that it incorporates correctly all of the physics and feedback mechanisms that are likely to be important as greenhouse gas concentrations or aerosol producing emissions increase. As discussed in Chapter 4, it is unlikely that all important feedbacks have been included correctly in current AOGCMs. Feedbacks involving clouds and the surface radiation budget are poorly understood, and different schemes for parametrizing cloud processes can lead to substantially different results in greenhouse warming experiments (Cess et al., 1989; Mitchell et al., 1989). Other feedbacks that are either currently neglected or highly uncertain include interactions between the land biosphere and the carbon cycle, and between climate and atmospheric chemistry (See chapters 2 and 4).). Deficiencies in the treatment and incorporation of feedbacks are a source of signal uncertainty" (WGI FSM, section 8.2.2, p. 416).

"Analysis of surface air temperature and precipitation results from regional climate change experiments carried out with AOGCMs indicates that the biases in present day simulations of regional climate and the inter-model variability in the simulated regional changes are **still too large to yield a high level of confidence in simulated change scenarios**.... This adds a further degree of uncertainty in the use of GCM-produced scenarios for impact assessments." (WGI FSM, section 6.6.3, p. 344)

"Although model performance has generally improved over the last decade, **both coupled and uncoupled models still show systematic errors** in their representation of the mean state and variability statistics of current climate (see Chapter 5, and also Gates et al., 1990, 1992). **Such errors reduce our confidence** in the capability of AOGCMs to predict anthropogenic change." (WGI FSM, section 8.2.1, p. 416)

"The so-called 'cold-start' problem results from the neglect of anthropogenic forcings (and hence some portion of the climate response) that happened before the start of the simulation....Such simulations are inevitably subject to a 'cold-start' error....Errors which the cold start effect may introduce into the time evolution of an anthropogenic signal constitute a further source of uncertainty in detection studies." (WGI FSM, section 8.2.6, p. 418)

DEVELOPING COUNTRIES

"First, for the purposes of analysis, *it is useful to separate efficiency from equity*....Second, **it is inappropriate to redress all equity issues through climate change initiatives**.... A third approach is based on contribution to the problem. Because the industrialized countries have contributed more than two-thirds of the stock of anthropogenic greenhouse gases in the atmosphere today, this approach seems to suggest that they have a larger responsibility for bearing the costs. On the other hand, by the time greenhouse gas concentrations double from preindustrial levels, **the developing countries are projected to be contributing more than half of annual emissions, and roughly half of the total stock in the atmosphere** (IPCC, 1990a; Cline, 1992). Thus, under this criterion, **the developing countries might eventually pay far more of the mitigation costs** than under the other principles described earlier. (WGIII, FSM, section 1.3.4.2 , p. 29).

"The controversial issues of population growth and consumption patterns, although central to economic development, bear on climate change largely through their effects on emissions. **Population growth in developing countries may also exacerbate the ecological and socioeconomic impacts of climate change.** (WGIII, FSM, section 1.3.4.2, p. 29)

"The potential for the **greatest growth in CO2 emissions**--in both percentage and absolute terms--is in the **developing world**...." (WGII FSM, Executive Summary, Chapter 22, p. 715)

"The **largest single additive impact** in all respects will come from **industrial growth in developing countries**." (WGII FSM, section 20.2.3.3, p. 657)

"...growth in both the number of households and in equipment stocks per household is **increasing much faster in the developing countries than in the industrial countries**, and the average efficiency of new equipment is lower because of the need to keep initial costs low...Thus, there is much potential to affect future CO2 emissions by **improving the efficiency** of residential buildings and appliances in these countries." (WGII FSM, section 22.4.1, p. 720)

"Implementation problems for energy-efficiency improvements in developing and transitional economies are more severe than those in industrial countries....Moreover, developing and transitional economies, in general, are characterized by lower overall productivity, including energy productivity. **One should not attempt to solve energy-efficiency problems in isolation from other efficiency problems**. Problems related to vintage equipment, scarcity of management skills, small-scale production, or poor technological infrastructure will not be solved by addressing climate-change or energy goals alone." (WGII FSM, section 20.5.3.2, p. 672)

"Alternatively, if the developed countries choose to embark on an aggressive control regime now, and if this cuts into their growth rates, the result will shrink export markets for developing countries and thus reduce growth there. In addition, if developed countries view their greenhouse efforts as, in effect, aid to developing economies, they may cut back on other programmes (sanitation, water, education for women, etc.) that have a more immediate impact on life expectancy, health, and well-being." (WGIII, FSM, section 1.4.2, p. 33)

SEA LEVEL RISE & THE HYDROLOGICAL CYCLE

"There is as yet no evidence for any acceleration of sea level rise this century...The evidence, or lack of it, for sea level accelerations over the past century depends critically on a small number of long tide gauge records which is unlikely to be supplemented significantly in the future." (WGI FSM, section 7.2.2, p. 366)

"In general, the **ocean is so poorly observed** and the instrumental record so incomplete that **there are regions of the ocean for which no observations exist**...Since there are now no continuous long-term measurement sites in the deep ocean, the establishment of such a system is important for the evaluation of climate models and for the measurement of the natural variability that is necessary for the unambiguous detection of a climate response to anthropogenic forcing (see Chapter 8)." (WGI FSM, section 5.3.3.4.3, p. 267)

"Changes in climate near ecosystem borders could mask impacts from harvesting excesses and other anthropogenic changes, generating **misguided international disputes**...**Globally, overfishing and diverse human stresses on the environment will probably continue to outweigh climate-change impacts** for several decades." (WGII FSM, section 16.2.2.3, p. 524)

"Regionally, and locally, **vertical land movement can be quite large**, even on the decadal time scale. For example, parts of Scandinavia experience uplift (and thus a relative sea-level decline) of about 1 meter per century...In contrast, **the Mississippi delta is experiencing subsidence** (a relative sea-level rise) **of about 1 m per century**..." (WGII FSM, section 9.3.1.2, p. 296)

"As **most of our observations extend over a few decades only, this immediately poses a problem**: how can we decide from observations whether a small change in ice sheet configuration is a response to a short-term climatic fluctuation or an ongoing process of slow adjustment to changes that happened a long time ago?" (WGI FSM, section 7.3.3.2, p. 374)

"Given our present knowledge, it is clear that while the ice sheet has had a very dynamic history, estimating the likelihood of a collapse during the next century is not possible. **If collapse occurs, it will probably be due more to climate changes of the last 10,000 years rather than to greenhouse-induced warming.**" (WGI FSM, section 7.5.5, p. 389)

"In Antarctica, recent break-ups of the Larsen and Wordie Ice Shelves in the Antarctic Peninsula and discharges of enormous icebergs from the Filchner and Ross Ice Shelves, and the discovery of major recent changes in certain Antarctic ice streams, have focused public attention on the possibility of 'collapse' of this ice reservoir within the next century, with potential impacts on sea level. **Changes in floating ice shelves, of course, cannot affect sea level directly.**" (WGI FSM, section 7.3.3.1, p. 374)

"...the short response of ice streams removes the flux imbalance at the grounding line so that the **purported instability may not exist.**" (WGI FSM, section 7.5.5, p. 389)

"No systematic changes of minima or maxima and **no general warming has been observed in the Arctic** over the last 50 years or so...." (WGI FSM, section 3.2.2.4, p. 146)

"Although some of the principal linkages between climate and hydrological system are well understood, **predicting the effects of global warming is very uncertain**. Current general circulation models (GCMs) work at a spatial resolution that is too coarse for hydrological purposes, producing weather averaged over too large a geographic area and producing average conditions rather than changes in ranges, frequencies, seasonal distributions, and so forth. **They do not yet include all of the relevant feedbacks between the land surface and the atmosphere.**" (WGII FSM, section 10.1, p. 329)

"**No clear evidence** of wide-spread change in the annual streamflow and peak discharges of rivers in the world was found." (WGI FSM, section 3.3.5.1, p. 158)

"Unfortunately, our ability to determine the current state of the global hydrological cycle, let alone changes in it, is hampered by **inadequate spatial coverage, inhomogeneities in climate records, poor data quality, and short record lengths.**" (WGI FSM, section 3.3.1, p. 152)

"Water vapour is the most abundant greenhouse gas and makes the largest contribution to the natural greenhouse effect....**Monitoring atmospheric moisture presents many difficulties**...Measurement problems also make detecting trends of water vapour difficult....These factors make it difficult to separate climate changes from changes in measurement programs (Elliott and Gaffen, 1991)." (WGI FSM, section 3.3.7, p. 161)

"**Future erosion risk is more likely to be influenced by increases in population density,** intensive cultivation of marginal lands, and the use of resource-based and subsistence farming techniques **than**

by changes in climate. One can anticipate that erosion, mass movement, and landslides are most likely to increase in and near regions of high population density." (WGII FSM, section 4.2.5, p. 176)

"The **existing climate models are not able to generate reliable estimates on regional temperature, precipitation, and hydrology**.... In addition, in order to assess the quantitative implications of ecophysiological processes under chronic climatic change, climate models must describe the regional and seasonal changes of temperature and precipitation." (WGII FSM, section 15.7.2, p. 507)

"**Forests themselves may to some extent acclimate or adapt to new climatic conditions**, as evidenced by the ability of some species to thrive outside their natural ranges. Also, **elevated CO2 levels may enable plants to use water and nutrients more efficiently** (e.g., Luo et al., 1994)." (WGII FSM , section 1.3.7, p. 113)

The Role of Technology

"**In the energy supply sector, we conclude with a high degree of confidence that GHG emissions reductions can be achieved through technology options**...." (WGII FSM, Executive Summary, Chapter 19, p. 589)

"....within a period of 50-100 years, the entire energy supply system will be replaced at least twice. New investments to replace an old plant or to expand capacity are **opportunities to adopt technologies that are more environmentally desirable at low incremental cost**." (WGII FSM, section 19.1, p. 591)

"Timing of reductions in greenhouse gas emissions should reflect differences in costs, discounting (to evaluate those costs), and risk. **If technological change will make future emission reductions much less costly, some reductions should be postponed**." (WGIII, FSM, section 1.3.3.2, p. 27)

"**Industrial GHG reductions can be achieved by good housekeeping** (operational performance), additional investments in energy-efficient technologies (both conversion and end-use equipment), or redesigning the manufacturing process itself (process innovation and integration)." (WGII FSM, section 20.5, p. 670)

"Greater use of available, **cost-effective technologies** to increase energy efficiency in buildings **could lead to sharp reductions in emissions of CO2** and other gases contributing to climate change." (WGII FSM, section 22.5.1, p. 731)

"Because future global industrial growth will take place largely in the developing and transitional economies, the **early transfer of advanced energy-conservation technology may be crucial to curb worldwide GHG emissions.**" (WGII FSM, section 20.5.2, p. 671)

AGRICULTURE

"If climate change is gradual, it may be a small factor that goes unnoticed by most farmers as they adjust to other more profound changes in agriculture stemming from new technology, increasing demand for food, and other environmental concerns such as pesticide use, water quality, and land preservation." (WGII FSM, section 13.9, p. 452)

"Given the wide range of microclimates already existing in mountain areas that have been exploited through cultivation of diverse crops, **direct negative effects of climate change on crop yields may not be too great.**" (WGII FSM, section 5.2.4.1, p. 204)

"While uncertainties continue to exist about the direction of change in global agricultural production resulting from climate change, changes in the aggregate level of production have been found to be small to moderate... **More recent work considering global agriculture under climate change found far greater potential for global agriculture to adapt to changing climate than earlier studies.**" (WGII FSM, section 13.8.2, p. 451)

THE ROLE OF TAXATION

"Internalizing environmental costs in energy prices and tariffs through ecotaxes is particularly problematic for the industrial sector because of the consequences for national competitiveness on international markets. **Taxes that are not levied on a global scale may provoke industry relocation,** which may adversely affect emissions efficiency as well as international competitiveness. Most countries are hesitant to embark on policy ventures that might endanger their international market position and their attractiveness as industrial locations...**It is difficult for a single nation to impose full environmental cost accounting and remain competitive unless other nations do the same.**" (WGII FSM, section 20.5.3.3, p. 673)

"One implication of general equilibrium theory has already been noted: **Taxes imposed on one part of the global economy may have little if any effect on global emissions**; they may simply result in a relocation of economic activity.... If, for example, the OECD countries impose carbon taxes on energy-intensive industries, those industries may relocate outside the OECD. Further, if greenhouse mitigation puts an economic drag on the developed countries, developing countries would be affected through trade. If different countries have different obligations to reduce greenhouse emissions, different implicit tax rates will result. **This will interfere with world economic efficiency--**

decreasing world real output--possibly with little effect on total greenhouse gas emissions." (WGIII, FSM, section 1.3.6, p. 31)

"Estimates range from $20 to $150 per tonne for the carbon taxes required to hold emissions at 1990 levels in 2010. Estimates of the carbon taxes required to reduce emissions by 20% below 1990 levels in 2010 range from $50 to $330 per tonne." (WGIII, FSM, section 9.2.1.1.3, p. 307)

"Based on the above findings, the study concludes that in the absence of effective controls on deforestation, **carbon taxes would create incentives to deplete forests for energy use.**" (WGIII, FSM, section 9.2.4.1.3, p. 327)

INSURANCE INDUSTRY

"Since the relationship between weather-related events and climate change is not known, insurance to cover the risks of climate change, *per se*, is probably not feasible or necessary." (WGIII, FSM, section 2.4.4, p. 71).

"There are several reasons for the escalation in the cost of severe weather. Developed countries have become wealthier. Many more people now live in coastal areas with costly infrastructures. Personal goods and business processes are generally more vulnerable to water damage. The built environment also contributes through inappropriate or incorrect design and construction. The insurance industry has compounded matters by extending the basis of coverage. It is a common perception in the insurance industry that there is a trend toward an increased frequency and severity of extreme climate events. **The meteorological literature fails to substantiate this in the context of long-term change, though there may have been a shift within the limits of natural variability.**" (WGII FSM, Executive Summary, Chapter 17, p. 541)

"World population is increasingly concentrated in urban areas, coastal regions, and river valleys (Marco and Cayuela, 1992). The concentration of property in such areas exposes insurers to potentially large losses from extreme events. Already, two-thirds of the world population live within 60 km of the coast; this is expected to rise to 75% by 2010 (IPCC, 1994)....**Prosperity has resulted in an increasing stock of personal property, often vulnerable to water, salt, and smoke damage.** Parallel changes have occurred in commercial/industrial properties." (WGII FSM, section 17.3.3, p. 545)

"The recognized source of information on future climate change is the general circulation model, or GCM...but at present **GCMs are of limited use to the financial sector**, for the following reasons:

- The length of model run is generally too short for statistical analysis of extreme events....
- For analysis of extreme events, model output may be required at the daily timescale....

- Current models cannot generate sufficient spatial detail....
- There may be a lack of consistency in model results...."

(WGII FSM, section 17.4.2, p. 546)

*Bold Highlights added.

WGI, WGII, WGIII = IPCC Working Groups One, Two and Three
FSM = Full Supporting Material, the peer reviewed portion of IPCC's work.

The full set of documentation is available from Cambridge University Press. Copies of portions of the FSM can be obtained from the Global Climate Coalition by calling Krista Johnson at (202) 628-3622.

[25715.4: 02/25/97]

- focus on cumulative emissions

> will not see effects of climate change before 2030.

Kyoto Mandate

~~U.S. - Kyoto targets & mid-term stabilization of emissions.~~

Assessment Model

- world trade model combined w/ open econ. models for 80 countries.

Dr Thomas Rutherford - U of Co. - helped w/ model

> Countries that do not adopt additional commitments will also be affected through trade linkages.

> tighter limits produce larger impacts on all parties.

OECD countries

- reduction in GDP due to higher energy costs
- loss of competitiveness to non-participating countries.

Dev. Countries

"income effect" - loss in exports b/c customers in OECD are worse off.

> Delay in emissions target reduces econ impacts
 fr 2010 - to 2015.

> Assume Cap + Trade sys. - emissions caps w/ tradable credits.

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In December 1997, the governments of nearly 160 nations negotiated the Kyoto Protocol, a U.N.-sponsored agreement to reduce greenhouse gas emissions worldwide. If it takes effect, the Protocol would require the United States to cut its greenhouse gas emissions significantly —to a level 7% below the 1990 level— between 2008 and 2012.

While it is certain the Protocol would impose enormous burdens on America's economy, there is no scientific certainty that human activity affects global climate. Scientists also disagree whether the drastic actions called for by the Protocol would reduce greenhouse gas levels around the world.

The following comments by leading independent experts address the uncertainty of the science of global climate change and suggested links with human activity.

"We could be coming out of the colder phase and into a warmer phase of the cycle right now... It's probably fair to say that we're seeing a component of natural variability."

Dr. Gerard Bond, Lead Researcher, Lamont Doherty Earth Observatory, *The New York Times*, November 18, 1997.

"Global warming is not proven."

Sir John Mason, Chair, Graduate School of Environment, Imperial College's Center for Environmental Technology, *Reuters World Service*, July 15, 1997.

"The simple fact is that today's computers still cannot replicate what is already known about climate changes over the past 50 years. When given data on climate that is a matter of historical record, the models do not reach the correct result."

Dr. Edgar Berkey, President, Center for Hazardous Materials Research, and Member of the U.S. Environmental Protection Agency Science Advisory Board, *Dayton Daily News*, June 9, 1997.

"I believe there is still great uncertainty about the climate system response to increasing levels of greenhouse gases."

Dr. Roy Spencer, Meteorologist and Team Leader, NASA Marshall Space Flight Center, *Investor's Business Daily*, October 6, 1997.

"Understanding the current state of the polar ice sheets is critical for determining their contribution to sea-level rise and predicting their response to climate change. Current estimates from decades of tide-gauge data indicate an increase in global sea level of 10 to 20 cm. over the past century. It is uncertain, however, what the individual contributions of the polar ice sheets are to sea-level rise at this time."

Curt H. Davis, Department of Electrical Engineering, University of Missouri; Craig A. Kluever, Department of Mechanical and Aerospace Engineering, University of Missouri; and Bruce J. Haines, Jet Propolsion Laboratory, California Institute of Technology, *Science*, Vol. 279, March 27, 1998

climate change: The case against scientific certainty

"Yes, there have been these big climate changes. But I think they're all natural."

Dr. William Gray, Climatologist, Colorado State University, *The New York Times*, September 7, 1997.

"In our view, the NRC [National Research Council] panel seriously underestimates the research effort required to reduce the uncertainty in the aerosol forcing to the specified level... In the absence of this research, knowledge of climate response to greenhouse forcing necessary for confident policymaking will be reliant entirely on climate models having little credible empirical confirmation."

Dr. Stephen E. Schwartz, Atmospheric Chemist, Brookhaven Institute; and Dr. Meinrat O. Andrene, Biogeochemist, Max Planck Institute, *Science*, Vol. 272, May 24, 1996.

"We figure half the climate change from 1850 to now can be accounted for by the sun."

Dr. Judith Lean, Solar Physicist, Naval Research Laboratory, *The New York Times*, September 23, 1997.

"The temperatures we measure from space are actually on a very slight downward trend since 1979 in the lower troposphere. We see major excursions due to volcanic eruptions like Pinatubo, and ocean current phenomena like El Niño, but overall the trend is about 0.05 degrees Celsius per decade cooling."

Dr. Roy Spencer, Meteorologist and Team Leader, NASA/Marshall Space Flight Center, NASA/Marshall Space Flight Center Web Site, February 6, 1997.

"There isn't a big case being made for the detection of greenhouse warming."

Dr. Brian Farrell, Professor of Meteorology, Harvard University, *The Washington Times*, July 1, 1997.

"As you increase CO2 [in the atmosphere], you don't see any increase in El Niños."

Dr. Tim Barnett, Intergovernmental Panel on Climate Change, Working Group I, Chapter 8, lead author on "Detection of Climate Change and Attribution of Causes," and Climatologist, Scripps Institute of Oceanography, *The Washington Post*, September 21, 1997.

"There's always a chance that what we're seeing happening is happening for natural reasons..."

Dr. Kevin Trenberth, Climatologist, National Center for Atmospheric Research, *Associated Press*, October 6, 1997.

"Some individuals will interpret the recent upswing in hurricane activity during 1995 and 1996 and the expected normal activity as evidence of climate changes due to increased man-made greenhouse gases... There is no reasonable way such an interpretation can be accepted."

Dr. William Gray, Climatologist, Colorado State University, *CEI Update*, Vol. 10, No. 7, June 1997.

"I believe we have a decade or so in which we can collect data and refine our models before we have to act."

Dr. Gerald North, Chairman, Texas A&M Department of Meteorology, *Cincinnati Enquirer*, October 25, 1997.

"Scientists and laypersons have a predilection for deterministic explanations of climate variations. However, climate can vary chaotically, i.e., in the absence of any forcing... The slightest alteration of initial or boundary conditions changes the developing patterns, and thus next year's weather is inherently unpredictable."

Dr. James Hansen, NASA Goddard Institute for Space Studies, and 42 others, *Journal of Geophysical Research*, Vol. 102, No. D22, November 27, 1997.

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